Neurochemical Journal 2008 vol.2 N3, pages 175-182

Role of the cAMP cascade in the turnover of synaptic vesicles of the frog motor nerve terminal

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Abstract

In experiments with frog neuromuscular preparations we have shown with the use of electrophysiological (two-electrode voltage clamp) and optical (fluorescent exocytotic dye FM1-43) techniques that during high-frequency stimulation (20 imp/s, 3 min) the cyclic adenosine monophosphate (cAMP) system had a complex effect on the exo-endocytotic cycle of synaptic vesicles. The activation of cAMP-dependent enzymes (100 μM 8-Br-cAMP, 50 μM Bt2-cAMP) was accompanied by facilitation of exocytosis of the vesicles from a ready-to-release pool and enhancement of the endocytosis of synaptic vesicles. However, transport of the vesicles from the mobilization pool to the ready-to-release pool was disturbed and transmitter release was supported by the vesicles from the reserve pool. Blockage of adenylate cyclase (1 μM MDL) suppressed exocytosis of the vesicles from the ready-to-release pool, hindered replenishment of this pool with vesicles from the mobilization and reserve pools, and impaired endocytosis. Thus, stimulation of the cAMP pathway promotes vesicle recycling via a slow pathway and maintenance of transmitter release during high-frequency activity via vesicles from the reserve pool, whereas the background activity of adenylate cyclase is necessary for the effective development of all the key stages of the vesicular cycle. © MAIK Nauka 2008.

http://dx.doi.org/10.1134/S1819712408030069

Keywords

cAMP, End plate currents, Endocytosis, Exocytosis, FM1-43, Recycling of synaptic vesicles, Vesicular pools